

NSLS-II Experimental Tools (NEXT)

August 2015 Project Activity

Report due date: September 20, 2015



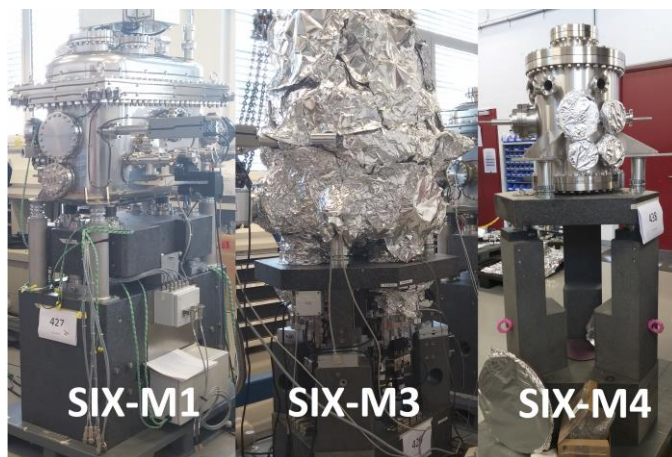
ISR Front End: Installation of the final ISR front end section, which includes lead collimator #2 and the dual safety shutters.



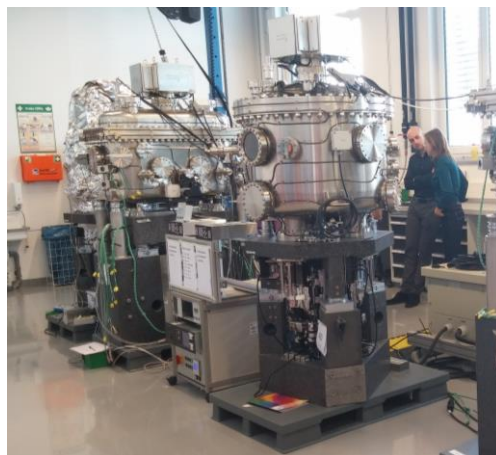
ISR FOE: Surveying of the ISR ratchet wall collimator.



ISR FOE: Gate valve #1 installed.



SIX M1, M3, and M4 mirror mechanical systems at Bestec's site on September 18, 2015. M1 and M3 are in the final stages of vacuum testing and M4 is in the final stages of mechanical assembly.



ESM M1 (left) and M3 (right) mirror tank at the BESTEC site.



ISS M1 and M2 mirror tank under bake at the Toyama site.

Steve Hulbert
NEXT Project Manager

OVERALL ASSESSMENT

During August 2015, progress continued to be made on all phases of the project, including managing major procurements, finalizing endstation designs, and installations. As of August 31, 2015, the project is 57.1% complete based on base scope performance earned to date. The cumulative EVMS schedule index remained stable in August, at 0.97. The cumulative EVMS cost index fell 0.03, to 0.93, driven by a large number of accruals and payments processed in August.

Five Level 3 PCRs were approved in August, three related to contract awards or amendments, one adding material and labor, and one reducing one beamline's endstation scope, with a net cost increase to baseline of \$65K. Details are provided on page 12. No major procurement contracts were awarded in August. One of two not-yet-awarded procurements, related to the second endstation of the SMI beamline, was removed from scope. As of the end of August, one major procurement remained to be awarded. Monitoring and management of contractor progress on the 63 major procurement contracts awarded to date remain as an important ongoing activity, one that is crucial to maintaining project schedule.

BAC rose slightly (\$0.06M) in August, to \$82.42M. Cost contingency is reported at \$7.58M, which represents 21.4% of \$35.4M BAC work remaining. The EAC, reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), rose \$0.64M in August, to \$86.2M, with a projected VAC of -\$3.78M. The majority of the VAC is a result of the reported \$3.66M cumulative cost overage on work performed to date, which is itself dominated by labor costs. The VAC also includes the cost of expected additions in beamline endstations, safety systems, and ID/FE installation.

If all of estimated VAC were to materialize, contingency would be reduced to \$3.8M, which represents 9.7% of \$39.1M EAC work remaining. With outstanding commitments totaling \$18.2M, the \$3.8M contingency on EAC represents 18.2% of \$20.9M unobligated EAC work to go.

The implementation of a monthly ETC based assessment of EAC, which helped to reveal some of the cost growth, will be continued through completion of the project to contain costs while maintaining the good schedule performance that the project has demonstrated to date.

COMMON SYSTEMS

NEXT mechanical and electrical utilities finishing work continued in August, with a focus on tagging of piping and working on "as built" drawings. The installation of utilities in the SIX endstation building, the most significant utilities installation remaining, will begin when requirements are finalized.

Acceptance testing of NEXT shielded enclosures (hutches) remained at 97% completion in July. Mitigation work by the contractor to remedy outstanding discrepancies in three

NEXT hutches began in August and is expected to be completed in October.

PPS design and development is well underway, with a focus on the installation of interlock conduit and hardware integration. This month, PPS interlock conduit installation of the A and B chains was completed at ISR, continues at ISS, and was started at SIX. Hardware installation at ESM continues this month, with a focus on the integration of hardware. The plan is for the certification of ESM PPS to occur during the December shutdown. In addition, the PPS team has been developing plans to adapt hatch interface points for compatibility with PPS hardware and the hatch suppliers have been engaged regarding remediation of mechanical interfaces. The majority (90%) of Personnel Protection System (PPS) components have been received. PPS installation work, while being part of one month behind schedule, is now being accelerated as resources previously deployed on ABBIX become available.

The Equipment Protection System (EPS) team is continuing to receive EPS requirements for each beamline, and participates actively in design reviews with vendors so that interface points between EPS and photon delivery components can be understood early. The procurement of EPS components is approximately 80% complete to date, with components continuing to be received as system definition matures. The passive interlock chassis that monitor vacuum were delivered and tested this month and will be installed in the equipment racks soon. The intelligent interlock chassis are due to arrive in September. Installation of EPS components is expected to start in late FY15, as beamline equipment is installed.

Control station furniture continues to be received for the NEXT project. Final configuration of the ISR control station is expected in September. In addition, it has been recommended that the SMI control station near its B-hutch be expanded to accommodate additional users.

BEAMLINE CONTROLS

During the NSLS-II machine maintenance period beginning this month, floor coordinator technicians from the Accelerator Operations group were made available to NEXT in order to accelerate cable pulling and cable termination activities. With their help, good progress was made on both of these activities during August. Figure 1 shows motor and encoder cable installations for one NEXT FOE, at both the controller and equipment ends.

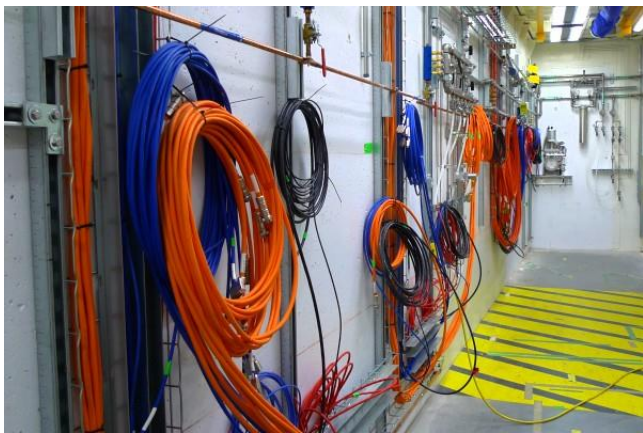
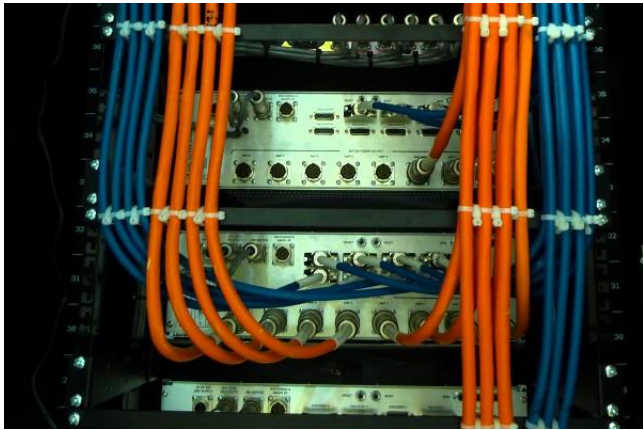


Figure 1: Motor and encoder cables pulled and terminated for one NEXT FOE, at the controller end (top) and coiled in the FOE, ready for component installation (bottom).

Good progress was also made during August on other control installation activities: network configurations have been finalized for all NEXT beamlines; controls network fiber has been pulled for ESM, ISR, ISS, and SMI; and EPICS IOC servers are in the process of being built and installed (4 out of 10 of these were built in August).

Control engineers continue to work with suppliers of photon delivery system and endstation components to iron out control issues and to participate in factory acceptance tests. Eight of the FPGA ("Pizzabox") electronics components that will capture, at high data rate, encoder positions for fly-scanning applications are being assembled for ISS beamline FOE optics motions.

The data storage and DAQ servers for SMI and ISR were received this month. Two standard Brocade network switches needed for fine tuning of the network configurations at these two beamlines were ordered and received.

A purchase order that will provide an additional 7.5 km of motor and encoder cables, the amount needed to complete NEXT motion control cabling, was placed in August. This requisition, for a total of 30 km of each cable, will provide motion cabling needed for the BDN and NPB projects and will yield cost benefits to each project via beneficial bulk pricing.

ESM – ELECTRON SPECTRO-MICROSCOPY

Construction activities were the focus of ESM effort in August. The most significant activities at the moment are mounting of electronic equipment (pump controllers, vacuum gauge controllers, and motor controllers) in the water-cooled equipment racks and termination of the corresponding cables. Mechanically, pedestals with extruded aluminum columns have been mounted at pre-drilled locations along the ESM floor to form the support structure for all beamline non-optics components. Finally, Bestec (supplier of the ESM PGM chamber and slits) returned for a week in August to finalize installation of the PGM internal mechanism. The PGM chamber assembly is now complete, is leak tight, and is under bake. The PGM optics (M2 mirror and four gratings) will be mounted and aligned by Bestec in January.

Three very important performance properties of the ESM beamline are its high flux at the sample position, high degree of spectral purity, and micro-focusing capability. All three characteristics are strongly dependent on the quality of the gratings. The principal characteristics of a grating are: the average density of grooves (lines) inscribed on the grating surface, the groove profile, and the non-linear variation of the groove spacing, which should precisely obey the so-called variable line spacing (VLS) law.

The average groove density determines the energy dispersion and therefore the energy resolution of the beamline. The groove profile is the shape of each groove (hill and valley width and the relative depth), which is designed to optimize the efficiency of the grating while retaining the maximum possible higher order rejection ratio and therefore the spectral purity of the light transmitted by the monochromator. The variation of groove spacing along the length of the grating, which obeys the VLS law, is optimized for the best focusing (cancelling of optical aberrations) in the vertical direction at the exit slits. VLS is therefore an integral part of the focusing strategy of the beamline.

During August, an extensive characterization of all these characteristics was carried out for three (out of four) ESM gratings at the metrology facility associated with the Soleil synchrotron in Paris (France). For each grating, AFM scans on several locations of the optical surfaces were conducted to verify the quality and homogeneity of the profiles. The VLS laws were measured using a very accurate and calibrated LTP instrument equipped with a HeNe laser mounted in the Littrow geometry. Finally, first and second order efficiencies in the soft X-ray range were measured at the Soleil METRO beamline.

Photos of the METRO beamline and its experimental apparatus are shown in Fig. 2. The efficiency of the grating is probed as a function of photon energy by measuring the intensity of the light diffracted in the first (or second) order normalized by the intensity of the direct beam. The results of these measurements were that all three gratings are of very high quality: the AFM profiles show very sharp steps and the correct duty cycle ratio; the VLS laws are perfectly on specs; and a qualitative comparison of the measured efficiency of the

first order with model simulations reveals close agreement between the two.

In the next few months, we plan to compare quantitatively the collected data to new theoretical simulations of grating efficiency, in both first and second order. The simulations can be improved substantially by including, as inputs, the quantitative measurements of the grating groove profiles and the measured VLS functions.

The metrological characterization of the actual ESM gratings, especially the at-wavelength measurement of diffraction efficiency, is an important contributor to ensuring the success of the ESM beamline to meet its performance goals. When commissioning the beamline, if the energy resolution or the intensity does not meet expectations, we will know that this cannot be due to insufficient quality of the gratings. That is, one of the most probable causes of less-than-expected beamline performance has been eliminated.

The fourth ESM grating is presently in fabrication and will be finished in September. We are arranging with the metrology group at Soleil to use their facilities again, to characterize this grating, before the end of 2015.

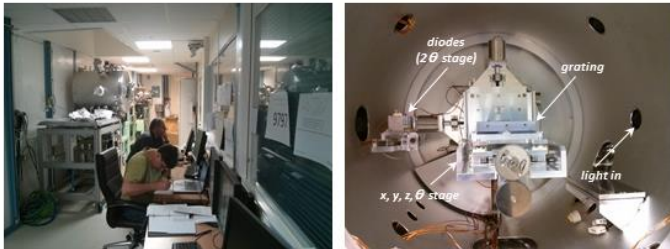


Figure 2: Left: Late evening at the experimental control station of the METRO beamline at Soleil. The large vacuum vessel (top left corner) contains the θ - 2θ stage for the characterization of optical components. Right: inside the θ - 2θ chamber: an ESM grating is mounted on the x,y,z, θ stage manipulator and the diode detectors are mounted on the independent 2θ rotation stage. Soft x-rays from the METRO beamline enter through the flange on the right.

FXI – FULL-FIELD X-RAY IMAGING

The FXI radiation enclosure (hutch) contract is proceeding on schedule, with fabrication complete at Caratelli's site and shipment underway, for delivery in September, followed by on-site construction.

ISR – IN-SITU AND RESONANT HARD X-RAY

A purchase order for the diamond window was placed with Applied Diamond, Inc., on August 31, with a delivery date of December 31. Requisitions for the remaining two changeover stands were routed for approval. Both of these stands, one of which is fixed and the other mobile, will be located in 4-ID-C between the high-field magnet endstation and the 6-circle diffractometer. The fixed stand will support two slides, a set of high-vacuum slits, and a pump-out port. The mobile stand

will support the incident flight path for the 6-circle diffractometer, or the downstream beam pipe in 4-ID-C when the *in-situ* endstation in 4-ID-D is in use.

A drawing of the beam path was released on August 4, and a survey request was initiated to mark the beam path on the experimental floor.

A model (see Figure 3), drawings, and pump down calculations for the ISR Dual Phase Plate Assembly vacuum chamber were received from Huber. The overall design of the chamber is acceptable, but the long bellows between the ion pumps and chamber need to be modified due to space constraints inside the FOE. In addition, vacuum conductance calculations indicate that additional pumps may be required in order to achieve the specification on the maximum time to achieve a pressure of 2×10^{-8} mbar.

The final acceptance test for lead hutch 4-ID-A was successfully completed. All four ISR hutches have now been accepted. The refurbishment of three transferred (from Building 725) pumping stations was also completed.

The final two slides, which will be mounted on the fixed stand described above, were received on August 19.

Part of the ISR DAQ, the IBM data storage system, was received on August 25. The rest of the ISR DAQ is due to arrive in early September.

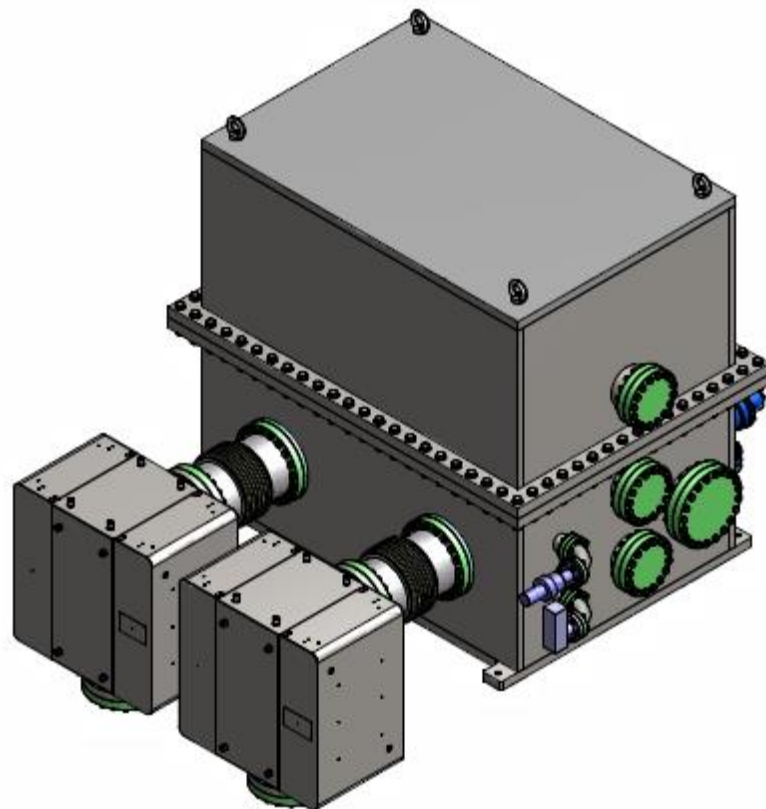


Figure 3: Model of the ISR Dual Phase Plate Assembly vacuum chamber, which is being designed and built by Huber subcontractor PINK GmbH Vakuumtechnik.

ISS – INNER SHELL SPECTROSCOPY

The high heat load monochromator system has been shipped from Toyama to BNL for installation beginning in mid-October. The Factory Acceptance Test (FAT) of all other packages forming the PDS (filter box, collimation mirror system, focusing mirror system, and beam transport) will be held in September. Installation of the ISS PDS should be completed by the end of December 2015.

To support efficient commissioning of the PDS without beam, installation of the control servers, the computer network, the first EPICS IOC servers, and the motor drivers for the FOE have been installed. All cables in the FOE have been pulled and terminated, ready for the connection of the equipment.

All vacuum equipment needed for installation and commissioning of ISS PDS is in hand, including gate valves, bellows, corner valves, turbo pumps, and gauges.

A secondary bremsstrahlung collimator stand, the final component of the PDS not yet in the process of being constructed, was added to the beam transport system package. It will be received in the second shipment from Toyama which is expected to arrive at BNL at the end of November. The lead bricks for the bremsstrahlung collimators and the bremsstrahlung stop, purchased by BNL, will be delivered in September.

To accelerate readiness of the ISS PDS for IRR, preparation of the necessary documentation is underway, including updating as-built drawings, initiating installation travelers, and updating ray tracing documents with as-built drawings of the radiation components. The final ray tracing review is expected to be held in December. The current planning is to hold the ISS PDS IRR at the end of March 2016, six months ahead of the NEXT project internal early project completion milestone.

Part 2 of the PDR of the spectrometer package and the FDR of the sample chamber were both held with PI-Micos in August. At the former, all interfaces between the spectrometers/detectors and the sample chamber were identified, an essential prerequisite to finalizing the sample chamber design shown in Figure 4. By minimizing the space requirements of all detection systems and optimizing the flange layout of the sample chamber and its interface with the hexapod system, all possible 90mm ports can be equipped with spectrometers (spherical backscattering analyzers or von Hamos spectrometers) and all 55mm ports can be used for silicon drift detectors. In addition, one race-track flange with 110mm x 30mm opening has been provided on the outboard side. This flange provides sufficient angular space for incorporation of a large acceptance angle spectrometer system in the 90-degree geometry which is typically used in spectroscopy to minimize background caused by elastic scattering.

An additional race-track flange (55mm x 35mm) on the downstream end of the sample chamber has also been provided to provide powder diffraction capability, an important feature for in-situ and operando experiments. This feature will utilize the quick adjustment capability of the

focusing poly-capillary lens system provided an integrated hexapod, allowing fast switching between highly divergent micro-focused beam and conventionally focused beam.

The sample transfer system package, containing all equipment which will allow the transport of samples from a glove box to the sample chamber and loading the sample into the chamber under inert gas or vacuum conditions, will be provided by a contract awarded to Square One. A kickoff meeting was held at Square One in August, at which the available space envelope and interface points to the sample chamber were presented to and discussed with the Square One design team.

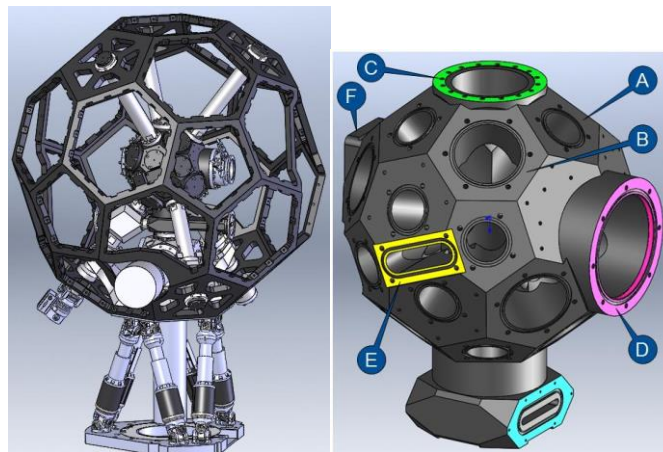


Figure 4: Final design of the ISS sample chamber assembly. Overview (left), showing the positioning hexapod system, the sample loading chamber with exclusion zones for the sample transfer system, the mounting frame with mounting points to support the spectrometers, and the sample chamber. Layout (right) of the sample chamber with customized 55 mm (free aperture) flanges on its pentagonal facets (A), customized 90 mm (free aperture) flanges on its hexagonal facets (B) and a DN100 CF flange (C) at the top. Additionally, a custom flange (D) has been added for insertion/removal of the focusing lens hexapod. An outboard-side race-track flange perpendicular to the beam direction has added (E), as has a second race-track flange (F) on the downstream end.

SIX – SOFT INELASTIC X-RAY

After holding the FDR for the SIX spectrometer arm system contract with Bestec on July 8 and a post-FDR phone call in the first week of August, it became apparent that the colossal scope of work that needs to happen between the FDR and the release of manufacturing drawings for production needed to be broken down into sub-units with dedicated mini-reviews. Bestec set a schedule for a series of five production release call-in mini-reviews stretching from the end of August through the end of September. The addition of these mini-reviews to the program plan is not affecting the delivery and installation schedule. Figure 5 shows the layout of the main parts that were approved during the first of these mini-reviews held on August 28: the sample chamber inner mechanics and its stand, the optics wheel, and the M5 hexapod system. Bestec placed the order for the plane deflecting mirror M7

with JTEC on August 25. This mirror, which is part of the scope for the new spectrometer optical design, will have a 50 nrad slope error over an active optical area of 525 mm x 40 mm.

The FAT of the M1 and M3 mechanical systems for ESM and SIX was held at the Bestec site on August 13-14. Only a portion of the tests needed for approval of shipment were completed, which resulted in the need to set a schedule for a follow-up FAT call-in review in mid-September. Tests completed on August 13-14 include the vacuum of the SIX-M1 system and the repeatability and stability of the motions for all four systems. Awaiting test completion are the vacuum of the remaining three systems, the resolution of all motions, and the pressure for the cooling lines of M1.

The kick-off meeting for the sample chamber and triple rotating flange system was held with Bestec by phone on August 10. The benefit of having the same supplier in charge of this package as well as the spectrometer and M4 packages became evident during this review, as a few volume interface interferences were identified and volume interface redesign for the spectrometer and M4 could be proposed 'on the spot' during the meeting.

On the SIX experimental floor, holes for the beamline pipe support stands were drilled and the stands installed. Bestec came to NSLS-II during the week of August 31 to complete the installation, without optics, of the SIX and ESM PGMs. Regarding the SIX PGM ultra-high vacuum status, leaks were found and fixed. The PGM will be subsequently baked and RGA tested by the NSLS-II Vacuum Group in September.

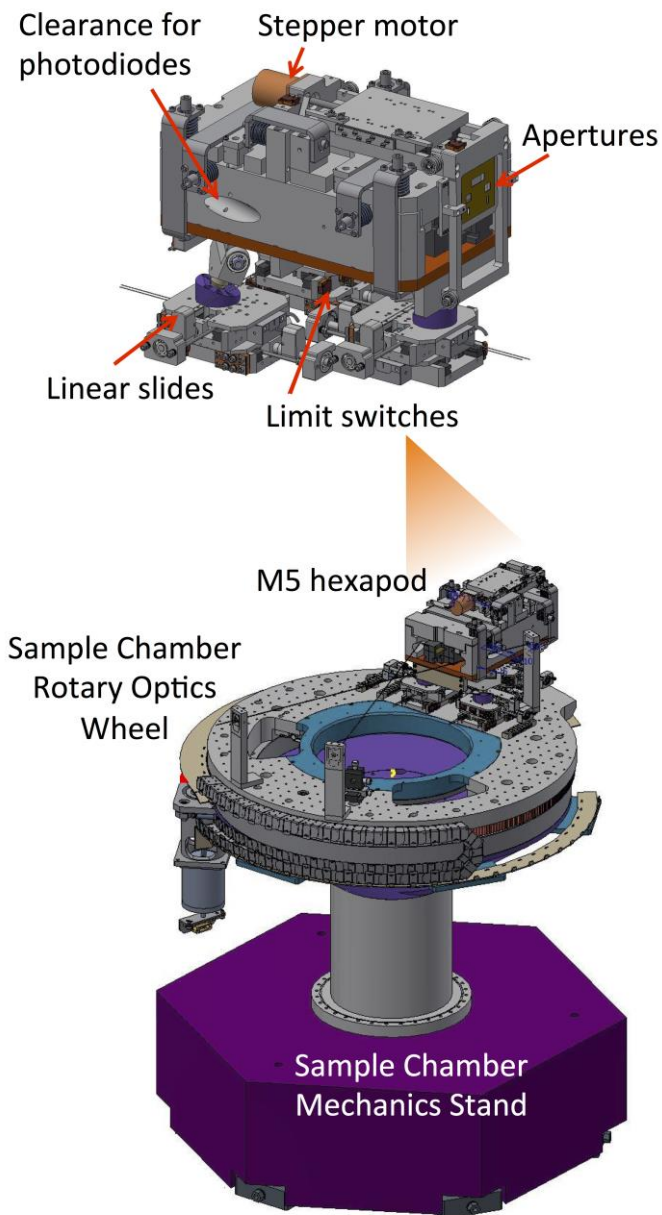


Figure 5: Final design of the SIX sample chamber inner mechanics and its stand, with a close-up view of the M5 mirror hexapod system. These parts were approved for production release on August 28.

SMI – SOFT MATTER INTERFACES

Specification documents for the SAXS Beam Chamber, the final NEXT major procurement contract to be awarded, were posted on FedBizOpps in August. Vendor queries were received within days, and their proposals are due on September 28, yielding high confidence that this procurement will be sourced ahead of the current working schedule. The FDR for the Vacuum Sample Stages contract with Physik Instrumente, consisting of hexapods, a rotation stage, and precision hardware, was completed this month and the long lead hexapod components have been ordered by the supplier.

The second of two FATs for the White Beam Components contract was conducted successfully at IDT's plant in Widnes (UK). With assistance provided by SMI staff, motor accuracy and repeatability tests were expanded to wider velocity range and greater number of repetitions. Raw data was analyzed independently by SMI scientists to determine the statistics. In addition to approving motion test protocols, SMI brought along a laptop equipped with NSLS-II controls software to demonstrate operation of the DCM using EPICS utilities supplied by IDT. These EPICS utilities are now fully parametrized to match SMI's DCM and ready to be installed on the SMI beamline computers that were purchased last winter. Figure 6 shows a few photos from the IDT FATs. The majority of IDT's equipment is now staged in Sector 12 for installation beginning early October (Figure 7), with one major shipment (DCM vessel and mechanics) and a few minor shipments (ion pumps) remaining.

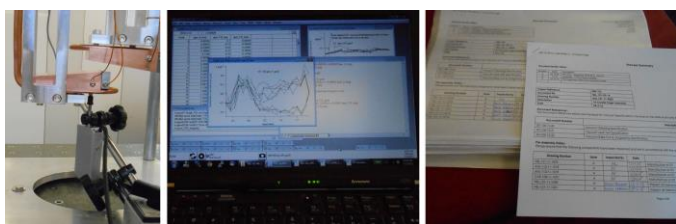


Figure 6: From left: Slit motion tests using linear sensor together with encoder readout; raw test data being re-analyzed by SMI scientists; review of all IDT subcontractor travelers and certifications.



Figure 7: Five of nine crates holding SMI White Beam Components received and staged for September installation.

Following minor fixes and successful mechanical and vacuum testing at the supplier's facility, the Sample Vacuum Chamber test results were approved in late August and the crate shipped at the end of the month, arriving during the first week of September. The Cryo-Cooler procurement, also requiring fixes and further factory testing by the supplier, was approved for shipment at the end of the month for delivery in September.

In August, NEXT project management determined that all not-yet-awarded procurements for beamline second endstations must be removed from scope. For SMI, the Double Crystal Deflector for the B endstation and associated activities were removed. Infrastructure that remains to be installed for the B endstation includes outboard and inboard beam transport and stops; the removable, shielded, interlocked beam pipe that will enable operations in 12-ID-C with access in B and vice versa; utilities, racks, and pulled cables corresponding to 32 motor channels plus 16 channels of fast encoder readout (FGPA units, so-called pizza boxes); and an EPICS IOC, beamline workstation, and associated controls components that can also function as spares for the primary SMI endstation. A team is forming within the NSLS-II Complex Scattering Program to propose paths forward including scope suitable for NEXT contingency spending, for Operations projects, and for Beamline Development Proposals to address the full canted build-out.

GISAXS/WAXS endstation activities being tracked in the NEXT schedule include procurement of the detector chamber; detail design and requisition activities for the table rail, XYZ mechanics, and cable management; and WAXS detector stages and brackets. When the design activities are complete, formal Endstation design review of this endstation will be undertaken. Activities in Beamline Non-Optics (C hutch vacuum, XBPM sensors/mechanics) and Small Valued Procurements (granite supports for WAXS chamber) are, collectively, approximately 50% complete at this time.

INSERTION DEVICES

The Preliminary Mechanical Acceptance Test (PMAT) of the Short EPU for ESM was conducted from July 22 to August 5, with participation of the subcontractor for design and manufacturing of the NEXT EPU mechanical frames, EUROMISURE S.a.S, a division of the WIKA Group (Pieve S. Giacomo, Italy). The purpose of the PMAT was for Kyma to formally accept these frames from EUROMISURE before mounting magnets on them. The PMAT consists of two parts. In the first part, mechanical forces whose magnitude are similar to or greater than the eventual EPU magnetic forces are applied to girders to ensure that deformation of the mechanics meets design requirements. The second part focuses on motion accuracy and repeatability. Examples of tooling and setup used during the PMAT are shown in Figure 8.

Staff from the NSLS-II Insertion Device and Controls groups visited the NEXT EPU contractor (Kyma) site from August 3-7 to witness the second part of the PMAT and to perform initial testing of the EPU control system. Successful completion of the PMAT requires demonstration of control system functionality. This visit also provided an opportunity for BNL controls staff to gain familiarity with the EPU control system and identify bugs months ahead of delivery.



Figure 8: Photos of the short EPU57 mechanical frame and some of the tooling and setup used during the PMAT.

Officine Famiglia Denti and Rotini, two of EUROMISURE's main subcontractors, were also visited in order to assess the current state of the manufacturing of the long EPU mechanical frames. The production is well underway. The machining and the welding of the double frame vertical tower were completed at Officine Famiglia Denti (see Fig. 9). The tubes connecting the vertical towers have also been machined by Officine Famiglia Denti. EUROMISURE received the magnet holders and platen for the ESM EPU105 from Rotini (see Fig. 10).

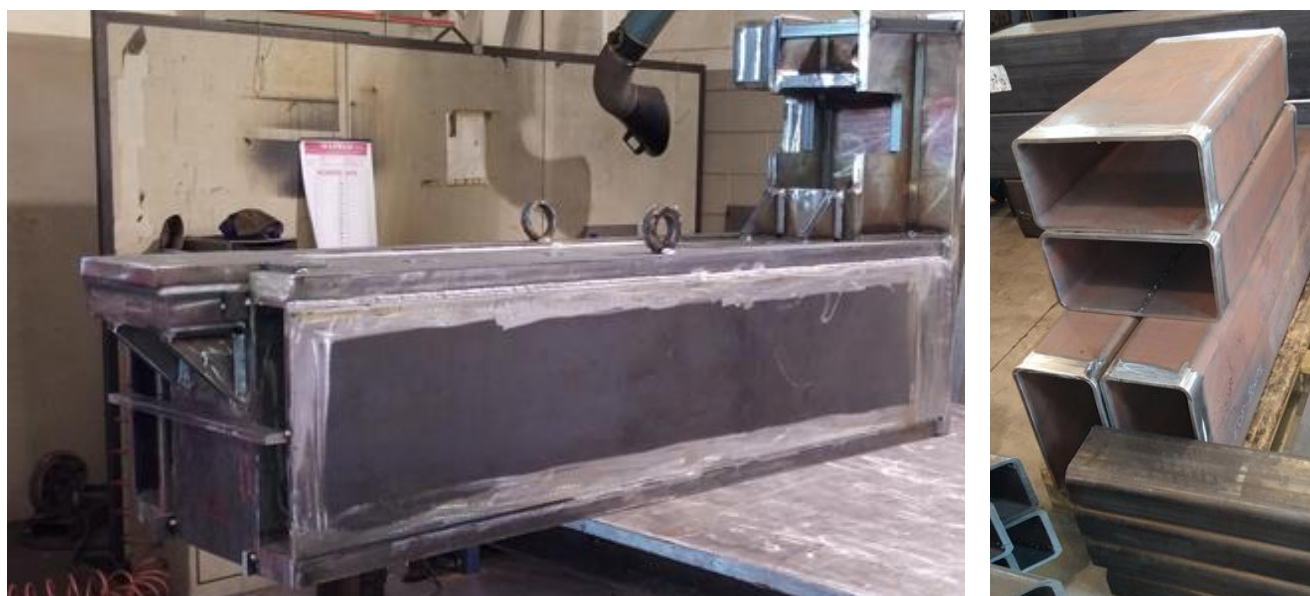


Figure 9: Double frame vertical tower (left) and tubing to be used to connect the vertical towers of the ESM and SIX long EPUs.

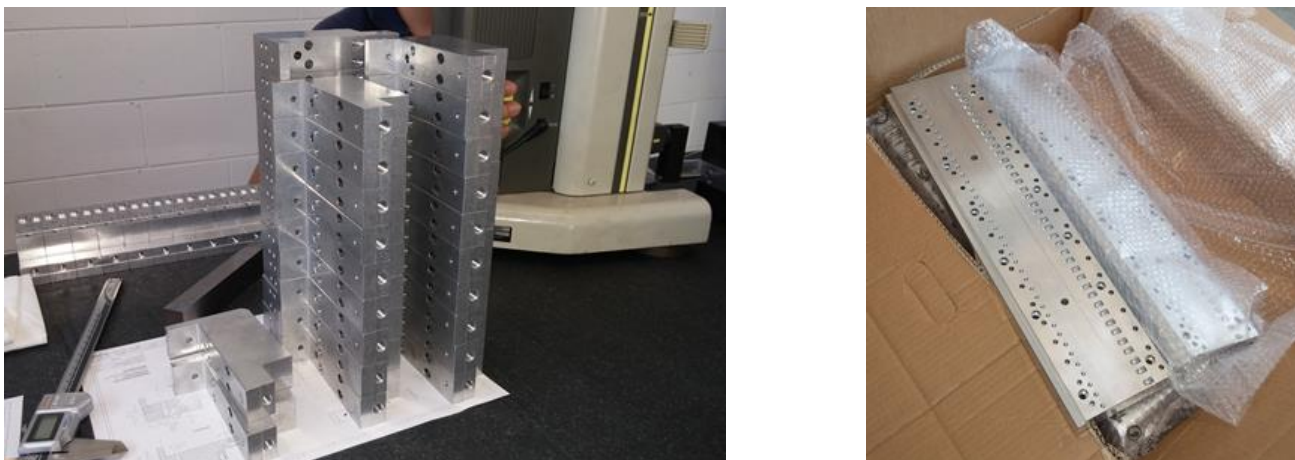


Figure 10: ESM EPU105 magnet holder (left) and platen (right).

ID/FE INSTALLATION

During this month, the ratchet wall collimators for ISS, ISR and SMI were installed. The ISR exit pipe (connection between the storage ring and the front end) has been installed. Plumbing and connection work is ongoing for the ISR and SMI front end stands in the SR tunnel. The ISR and ISS slits have been installed. Cable termination of the ISR and ISS slit stages and X-ray flags is in process. The ISR, ISS, and SMI x-ray flags have been installed. Wiring of the safety shutters, bending magnet photon shutters, and gate valve 1 for ISS, ISR, and SMI is in process in the SR tunnel. Compressed air has been tied in to the ISS and ISR front ends. The ISS front end is in the process of being baked.

The ISR IVU has been moved into position and rough aligned at the 4-ID straight section in the SR tunnel (Figure 11). The cables have been dressed and the vacuum connections are in process. The canting magnet stands have also been installed in the 4-ID straight section.

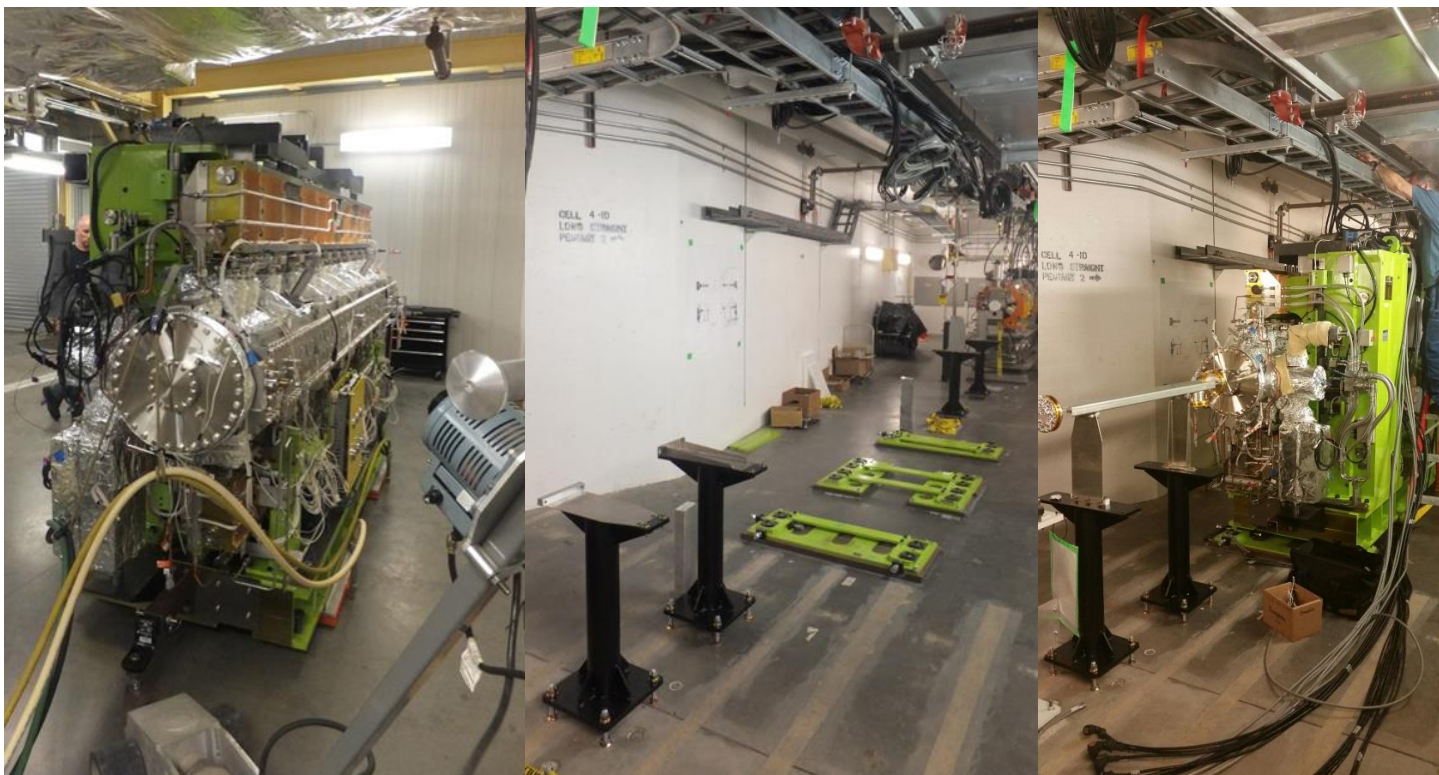


Figure 11: Photos of the ISR IVU in the service building close to straight section 4-ID (left); the straight section 4 before (center) and after (right) installation of the device.

PROJECT MILESTONES

Milestone	Planned	Actual
CD-0 (Mission Need):	May 27, 2010	May 27, 2010
CD-1 (Alternative Selection):	Dec. 19, 2011	Dec. 19, 2011
CD-2 (Performance Baseline):	Oct. 9, 2013	Oct. 9, 2013
CD-3A (Long Lead Procurement):	Oct. 9, 2013	Oct. 9, 2013
CD-3 (Start Construction):	Mar. 31, 2014	Jul. 7, 2014
Internal Early Project Completion – Beamlines	Sept. 30, 2016	
Early Project Completion:	Jan. 31, 2017	
CD-4 (Project Completion):	Sept. 29, 2017	

UPCOMING EVENTS

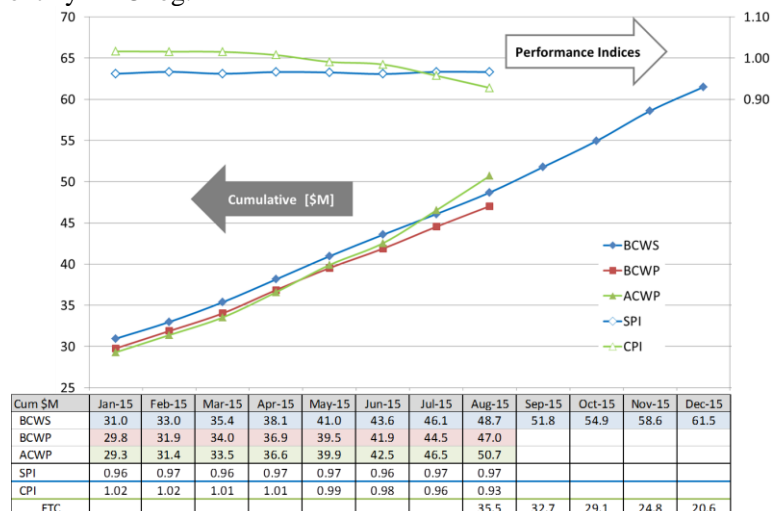
DOE/SC Status Review	November 3-4, 2015
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Acronyms and Abbreviations

ABBIX	Advanced Beamlines for Biological Investigations with X-rays	IOC	Input Output Controller
ACWP	Actual Cost of Work Performed	IRR	Instrument Readiness Review
AFM	Atomic Force Microscope	ISR	Integrated In-Situ and Resonant X-ray Studies
BAC	Budget at Completion	ISS	Inner Shell Spectroscopy beamline
BDN	Beamlines Developed by NSLS-II	IVU	In-Vacuum Undulator
BCWP	Budgeted Cost of Work Performed	JTEC	JTEC (Corporation, Kobe, Japan)
BCWS	Budgeted Cost of Work Scheduled	LTP	Long Trace Profiler
BHSO	Brookhaven Site Office	M&S	Material & Supplies
BNL	Brookhaven National Laboratory	METRO	Metrology and Test beamline (Soleil)
CD	Critical Decision	NEXT	NSLS-II Experimental Tools project
CPI	Cost Performance Index	NPB	NSLS-II Partner Beamline
CV	Cost Variance	NSLS-II	National Synchrotron Light Source II
DAQ	Data Acquisition	OPC	Other Project Costs
DCM	Double Crystal Monochromator	PCR	Project Change Request
DOE	Department of Energy	PDR	Preliminary Design Review
DOF	Degree of Freedom	PDS	Photon Delivery System
EAC	Estimate at Completion	PGM	Plane Grating Monochromator
EPICS	Experimental Physics and Industrial Control System	PMAT	Preliminary Mechanical Acceptance Test
EPS	Equipment Protection System	PMB	Performance Management Baseline
EPU	Elliptically Polarizing Undulator	PPS	Personnel Protection System
ES&H	Environment, Safety & Health	RGA	Residual Gas Analyzer
ESM	Electron Spectro-Microscopy beamline	SBA	Spherical Backscattering Analyzer
ETC	Estimated Cost to Complete	SC	Office of Science
EVMS	Earned Value Management System	SIX	Soft Inelastic X-ray Scattering beamline
FAT	Factory Acceptance Test	SMI	Soft Matter Interfaces beamline
FDR	Final Design Review	SPI	Schedule Performance Index
FE	Front Ends	SR	Storage Ring
FOE	First Optics Enclosure	SV	Schedule Variance
FPGA	Field-programmable Gate Array	TEC	Total Estimated Cost
FTE	Full Time Equivalent	TPC	Total Project Cost
FXI	Full-field X-ray Imaging beamline	UB	Undistributed Budget
FY	Fiscal Year	VAC	Variance At Completion
GISAXS	Grazing Incidence SAXS	VLS	Variable Line Spacing
IBM	International Business Machines (Corporation)	WAXS	Wide Angle X-ray Scattering
ID	Insertion Device	WBS	Work Breakdown Structure
IDT	Insertion Device Team	WS	Working Schedule
IOC	Input Output Controller	XBPM	X-ray Beam Position Monitor
		XES	X-ray Emission Spectrometer

COST AND SCHEDULE STATUS

Cost and schedule progress is being tracked using an Earned Value Management System (EVMS) against the cost and schedule baseline established on October 1, 2013. All baseline changes are being controlled through the NEXT Change Control Board. Cost and schedule revisions are being managed using Project Change Control procedures. From June 2015 forward, EAC is reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), at the individual activity and resource level. ETC values are shown in the final row of the EVMS table below, and all EAC changes are captured in the monthly EAC log.



The NEXT project Schedule Variance (SV) for August 2015 is -\$120K, with an associated monthly Schedule Performance Index (SPI) of 0.95 (green status). The cumulative SPI is 0.97 (green status), the same as it was in July 2015. The modest negative current month schedule variance is the net result of an equal number of number positive contributors (5) and negative contributors (5), with the negatives outweighing the positives. The largest positive contributor is +\$160K in WBS 2.04.02 (Control System Design & Implementation) as a result of catching up on installation work previously delayed, while the largest negative contributor is -\$159K in WBS 2.09.02 (SIX Beamline Systems) resulting from delays in the procurement of non-optics components (-\$55K) and delays in design activities related to the

spectrometer arm (-\$114K). The NEXT project Cost Variance (CV) for August 2015 is -\$1670K, with an associated monthly Cost Performance Index (CPI) of 0.60 (red status). The primary contributors to the monthly CV in August are: -\$107K in WBS 2.05.02 (ESM Beamline Systems), -\$225K in WBS 2.06.02 (FXI Beamline Systems), and -\$1,268K in WBS 2.08 (ISS Beamline Systems), resulting from the combined effects of payments and accruals for work earned in earlier months and labor cost overages. The cumulative CPI is 0.93 (green status).

As of August 31, 2015, the project is 57.1% complete with 21.4% contingency (\$7.6M) for \$35.4M Budget At Completion (BAC) work remaining, based on PCRs processed and approved through August 2015.

The project EAC for August is reported at \$86,201K against a Performance Measurement Baseline (PMB)/Undistributed Budget (UB) of \$82,424K. The Variance At Completion (VAC) is given by $VAC = BAC - EAC$, with $EAC = ACWP + ETC$. Through August 2015, VAC (-\$3,777K) is dominated by the reported \$3.66M cumulative cost overage on work performed to date. This overage is dominated by labor as opposed to M&S. VAC also includes the cost of expected additions, in beamline endstations, safety systems, and ID/FE installation.

The contingency (\$7.6M) is 19.4% of \$39.1M EAC work remaining.

5 PCRs were approved and implemented in August.

PCR	PCR Level	Baseline Change [\$]	Description
PCR-15-097	L3	101,449	ISR 5 DOF Table Award, DAQ Procurement Refinements
PCR-15-096	L3	454,247	ISS Contract Awards and Contract Amendments
PCR-15-090	L3	237,603	Additional Material and Labor for Utilities Installation
PCR-15-098	L3	(209,811)	Sample Chamber Award & Spectrometer Amendment
PCR-15-099	L3	(518,906)	SMI Endstation Scope Reductions

Only one PCR is forthcoming in September: PCR NEXT_15_100, a Level 3 PCR in WBS 2.08.02 (ISS Beamline Systems) to implement ISS High Heatload Monochromator and Shielded Beam Transport Contract Amendments.

NEXT as of 8/31/2015	Current Period	Cum-to-Date
Plan (BCWS) \$K	2,625	48,684
Earned (BCWP) \$K	2,505	47,031
Actual (ACWP) \$K	4,175	50,695
SV \$K	-120	-1,653
CV \$K	-1,670	-3,665
SPI	0.95	0.97
CPI	0.60	0.93
Budget at Completion \$K (PMB [UB])		82,424
Planned % Complete (BCWS/BAC)		59.1%
Earned % Complete (BCWP/BAC)		57.1%
Contingency \$K		7,576
Contingency / (BAC – BCWP)		21.4%
EAC \$K		86,201
Contingency / (EAC – BCWP)		19.3%
(Contingency + VAC) / (EAC – BCWP)		9.7%
TPC = PMB + Contingency		90,000

SPI Project to Date*:

0.97

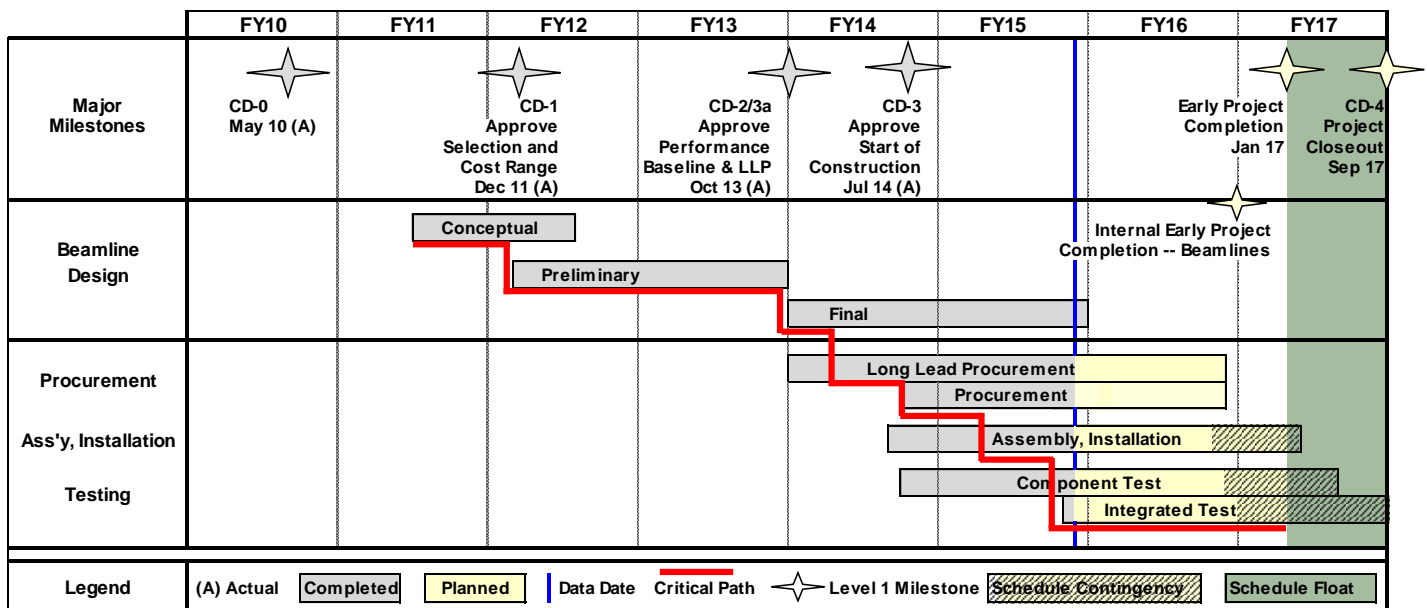
CPI Project to Date*:

0.93

*Cause & Impact: No reportable variance
Corrective Action: None required

Milestones – Near Term		Planned	Actual	Notes
L2	Receive 1 st Soft X-ray Grating	10-Mar-15	1-Jul-15	
L2,L3	Receive ISS Gas Handling System	17-Mar-15	22-Jul-15	Extensive ESH review
L3	SIX – Award Spectrometer Grating Chamber	17-Mar-15	4-Feb-15	
L3	ISS – Award XES Spectrometer	21-May-15	5-Jun-15	
L3	ESM – Testing Monochromator and Slits complete	12-Nov-15		
L3	ISR – Bench Test of Dual Phase Plate Assembly Complete	17-Nov-15		~Mar-16 (forthcoming PCR)
L3	SMI - Bench Test of DCM Monochromator Complete	30-Nov-15		WS: 9-Nov-15
L3	ISS – Testing High Heatload Monochromator Complete	5-Jan-16		WS: 9-Feb-16
L2, L3	Common Beamline Systems: Mechanical Utilities Installed	14-Jan-16		
L3	Common Beamline Systems: Electrical Utilities Installed	20-Jan-16		
L3	SMI – Installation of CRL Focusing Optics Complete	26-Jan-16		
L2	Receive 1st Double Crystal X-ray Monochromator	16-Feb-16		WS: 8-Sep-15

PROJECT SCHEDULE



The project critical path runs through activities in WBS 2.09 (SIX beamline). As of August 2015, the active critical path runs through design, procurement, fabrication, delivery, installation, and testing activities, including integrated controls testing, of the SIX Sample Chamber. This chamber features a triple rotating seal which permits the SIX emission spectrometer to rotate about the sample position through an angular range of 114 degrees while maintaining ultra-high vacuum.

Staffing Report

Staffing as of 8/31/2015	Current Period		Cumulative-to-Date	
	Planned ** (FTE-yr)	Actual (FTE-yr)	Planned ** (FTE-yr)	Actual (FTE-yr)
WBS 2.01 Project Management and Support	1.02	0.84	30.28	28.47
WBS 2.02 Conceptual and Advanced Conceptual Design	0.00	0.00	8.74	8.74
WBS 2.03 Common Beamline Systems	0.96	0.63	14.41	6.10 *
WBS 2.04 Control System	1.18	0.79	12.22	11.50
WBS 2.05 ESM Beamline	0.13	0.54	10.23	10.97
WBS 2.06 FXI Beamline	0.00	0.03	4.62	4.54
WBS 2.07 ISR Beamline	0.22	0.41	10.39	9.83
WBS 2.08 ISS Beamline	0.21	0.43	9.51	10.00
WBS 2.09 SIX Beamline	0.36	0.63	13.58	14.81
WBS 2.10 SMI Beamline	0.55	0.34	9.54	9.55
WBS 2.11 Insertion Devices	0.14	0.37	3.46	2.72
WBS 2.12 ID & FE Installation	0.31	1.72	2.43	4.83
Total	5.09	6.73	129.41	122.06

** Based on the NEXT working schedule

* More than half of utilities installation was performed by contractors (M&S) rather than staff as originally planned

Number of individuals who worked on NEXT during August 2015: 159

Funding Profile

Funding Type	NEXT Funding Profile (\$M)						
	FY11	FY12	FY13	FY14	FY15	FY16	Total
OPC	3.0						3.0
TEC – Design		3.0	2.0				5.0
TEC – Fabrication		9.0	10.0	25.0	22.5	15.5	82.0
Total Project Cost	3.0	12.0	12.0	25.0	22.5	15.5	90.0

Key NEXT Personnel

Title	Name	Email	Phone
Federal Project Director	Robert Caradonna	rcaradonna@bnl.gov	631-344-2945
NEXT Project Manager	Steve Hulbert	hulbert@bnl.gov	631-344-7570

COST PERFORMANCE REPORT

CONTRACT PERFORMANCE REPORT FORMAT 1 - WORK BREAKDOWN STRUCTURE											FORM APPROVED OMB No. 0704-0188
1. CONTRACTOR			2. CONTRACT			3. PROGRAM			4. REPORT PERIOD		
a. NAME Brookhaven National Laboratory			a. NAME NEXT			a. NAME NSLS-II Experimental Tools (NEXT) Project			a. FROM (YYYYMMDD)		
b. LOCATION (Address and ZIP Code)			b. NUMBER			b. PHASE			2015 / 08 / 01		
			c. TYPE			c. EVMS ACCEPTANCE			b. TO (YYYYMMDD)		
			d. SHARE RATIO			X YES			2015 / 08 / 31		
WBS (2)			CURRENT PERIOD			CUMULATIVE TO DATE			AT COMPLETION		
WBS (3)			BUDGETED COST			BUDGETED COST			BUDGETED		
ITEM			ACTUAL			ACTUAL			ESTIMATED		
SCHEDULED			VARIANCE			VARIANCE			VARIANCE		
(1)			(4)			(9)			(14)		
(2)			(5)			(10)			(15)		
(3)			(6)			(11)			(16)		
(7)			(8)			(12)			(13)		
(1)			(2)			(3)			(4)		
(5)			(6)			(7)			(8)		
(9)			(10)			(11)			(12)		
(13)			(14)			(15)			(16)		
2.01 Project Management and Support			189,680			189,680			263,497		
2.01.01 Project Management			78,173			78,173			54,774		
2.01.02 Project Support			111,506			111,506			208,724		
2.02 Conceptual Design and Advanced Conceptual Design			0			0			0		
2.03 Common Beamline Systems			125,406			188,165			232,774		
2.03.01 Utilities			87,035			105,774			88,148		
2.03.02 Personnel Protection System (PPS)			13,386			12,394			117,025		
2.03.03 Equipment Protection System (EPS)			7,353			35,957			28,603		
2.03.04 Control Station			8,801			25,211			6,201		
2.03.05 Common Beamline Systems Management			8,830			8,830			8,020		
2.04 Control System			45,015			205,153			147,748		
2.04.01 Control System Management			6,494			6,494			3,653		
2.04.02 Control System Design & Implementation			11,087			171,225			113,154		
2.04.03 Control System Equipment			27,434			27,434			30,941		
2.05 ESM Beamline			670,900			522,931			627,748		
2.05.01 ESM Management			10,986			10,986			8,395		
2.05.02 ESM Beamline Systems			659,915			511,945			619,353		
2.06 FXI Beamline			35,557			2,972			227,871		
2.06.01 FXI Management			0			0			0		
2.06.02 FXI Beamline Systems			35,557			2,972			227,871		
2.07 ISR Beamline			215,069			256,800			273,792		
2.07.01 ISR Management			26,293			26,293			27,414		
2.07.02 ISR Beamline Systems			188,776			230,506			246,378		
2.08 ISS Beamline			436,489			282,550			1,550,051		
2.08.01 ISS Management			19,008			19,008			30,051		
2.08.02 ISS Beamline Systems			417,482			263,542			1,520,000		
2.09 SIX Beamline			437,062			278,427			252,920		
2.09.01 SIX Management			17,991			17,991			13,782		
2.09.02 SIX Beamline Systems			419,071			260,436			239,138		
2.10 SMI Beamline			95,363			138,631			225,056		
2.10.01 SMI Management			23,516			23,516			9,613		
2.10.02 SMI Beamline Systems			71,847			115,114			215,443		
2.11 Insertion Devices			219,555			227,808			90,651		
2.11.01 ESM EPU Insertion Device			216,977			225,230			89,003		
2.11.02 SIX EPU Insertion Device			0			0			0		
2.11.03 Insertion Devices Management			2,577			2,577			1,649		
2.12 ID & FE Installation & Testing			155,102			212,032			283,387		
2.12.01 ID & FE Installation & Testing Management			2,581			2,581			4,416		
2.12.02 ID Installation & Testing			112,269			78,888			101,393		
2.12.03 FE Installation & Testing			40,252			130,563			177,578		
Total Project Baseline			2,625,197			2,505,147			4,175,496		
Undistributed Budget											
Management Reserve											
Performance Management Baseline - PMB			2,625,197			2,505,147			4,175,496		